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THE MAPPING OF BUFORD RESERVOIR

by F. C. Riley

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THE MAPPING OF BUFORD RESERVOIR

F. C. Riley

Bids for the mapping of the Buford Reservoir on the Chattahoochee River in Georgia were opened on February 24, 1953, with Park Aerial Surveys, Inc., of Louisville, Kentucky being the successful bidder. The work to be done under the specifications consisted of mapping, by Photogrammetric methods, an area of approximately 433 square miles. Of the total area, approximately 250 square miles were to be contoured, while maps covering the remaining 183 square miles were to show planimetric detail only.

The materials to be delivered under this contract consisted of the following:

All aerial photographic negatives and two sets of contact prints and two photographic indices.
All original compilation sheets.
One composite film negative and one composite film positive at a scale of 1:12,000 for each of the 44 three-minute quadrangles required to cover the area.
Six bound volumes of all map sheets.
All field books and notes used in establishing required control.
Linen tracings at a scale of 1:6,000 of 54 sheets 13,000 feet by 14,000 feet covering 350 square miles of the area.
One film negative with contours and one without, of each of 13 mosaic sheets covering 364 square miles of area.
Photography at a scale of 1:4,800 of the Chattahoochee River from the Buford Dam Site downstream for 50 miles.

The basic contour interval was 10 feet with auxiliaries at 5 feet interval. All work was to be done in accordance with standard map accuracies.

The purposes of these maps were for planning real estate mapping and acquisition, reservoir clearings, road and utility relocation and recreational planning.

In the ensuing paragraphs an effort will be made to describe as briefly and accurately as possible the methods and procedures used in fulfilling this contract.

The first step in the preparation of the maps by photogrammetric methods was to obtain suitable vertical aerial photography. It is essential that photographs to be used for this purpose be taken when trees are without foliage and that weather conditions be perfect with no snow, smoke, excessive haze or other conditions that would make the photographs unusable. In view of approaching Spring a photographic crew was assigned to this project as soon as notice to proceed was received. The crew, flying in a Cessna 195, consisted of a pilot and a photographer. It might be of interest to mention that such a crew, due to weather conditions, works but an average of approximately 400 hours a year. The mapping photography was accomplished with a Park Precision Camera containing a 6 inch Metrogon Lens flown at approximately 14,000 feet above the terrain, with eleven flight strips flown in an East-West direction. The overlap of photographs in line of flight averaged 60 per cent while side lap between flights was 30 per cent. The area was covered with approximately 150 photos.

The next step in the preparation of the maps concerned horizontal and vertical control, which is the foundation of any good map. The choice and amount of control was determined by the size and shape of the area, its accessibility and the number of photographs being used. Specifications required that the primary control be established with an accuracy not less than Third Order, with all Horizontal Control based on North American 1927 Datum and all Vertical Control based on Sea Level Datum of 1929.

All recovered existing control was spotted accurately on the photographs. This, however, was inadequate for mapping. An office engineer chose additional control points to be established. This was done with the aid of a stereoscope, and consisted of pricking and describing the points for which horizontal positions were required and for which elevations were desired. These points were all identifiable on the photos and were generally road intersections, fence corners, culverts, etc. The contract required that permanent monuments be set at intervals of approximately 3 miles. Approximately 100 miles of Third Order Traverse were run in order to establish 54 monumented stations and 139 horizontal picture points. Sixty eight miles of Third Order Levels were run to establish 41 permanent bench marks and 426 vertical picture points. In addition, bench marks were established on many of the Traverse Stations. The lines of Traverse were run with a 6 second Theodolite, a "Y" Level was used for level lines, while Plane Tables and Alidades were used for establishing vertical picture points. All control was completed in approximately 6 months.

Actual map compilation was started as soon as sufficient control had been completed and computed. Therefore relatively small areas were fully controlled and closed out Horizontally and Vertically.

While survey parties were running in control, office personnel were engaged in computing and constructing Polyconic Projections and Georgia Plane Coordinate systems for each three-minute map sheet at a scale of 1:6,000. After the projections were drawn on the sheets, the horizontal control was plotted. Maps may be compiled on good grade chart paper, Vinylite, fiber glass, metal mounted boards or other stable material.

Compilation was accomplished with Kelsh Plotters. This instrument is a two projector instrument which creates a stereoscopic model in space by utilizing the anaglyphic principles. Full scale glass plates made from the aerial negatives are used in the projectors. The images are enlarged five times by the Kelsh Plotter to create the stereoscopic or three dimensional model.

Each Kelsh Projector has a filter, one red and the other blue. The image is projected through the glass plates by pin-point light source on to a four inch white tracing table. In the center of this table is a small illuminated hole directly under which is a pencil lead. The tracing table may be raised or lowered to compensate for changes in ground elevations making it possible for the operator to "keep the dot on the ground." To view the model stereoscopically, the operator wears a pair of glasses containing one red and one blue lens. The glasses are worn so that the red lens will be on the same side as the red filter in the projector when facing the instrument. These colors are complimentary, thus the eye with the red lens sees only the image projected thru the red filter, and the eye with the blue lens sees only the image projected thru the blue filter.

The medium on which the grids were drawn and control plotted was placed on the instrument slate table. It was oriented to the stereoscopic model with respect to the plotted horizontal control and levelled with respect to the vertical picture control points and compilation was begun.

The usual procedure in compilation is to draw roads and railroads first. These are followed in order by buildings, fences, trails, woods and drainage. The contouring starts upon completion of all planimetric detail. It is helpful to the Operator and, later to the draftsman, to ink in some of the detail in standard colors such as blue for drainage, brown for contours, etc. In addition to developing 10 foot contours thruout the maps and supplementary 5 foot contours in the flat areas near the rivers, the 1075 and 1085, or critical contours were developed thruout. Spot elevations were established at bridges, drain crossings, road intersections, on tops and saddles.

One hundred and two stereoscopic models were used in the compilations of the forty-four 3 minute quadrangles, with the compilation being completed in approximately eight months.

When the Kelsh compilation was finished, the resulting map or manuscript was checked thoroughly by a map editor for completeness of contouring and planimetric detail. The names of towns, rivers, creeks and other local features were lettered in, utility line ownership was shown, and road classification was noted. The map was then ready for drafting.

Final map sheets were to be furnished to the Corps of Engineers in two forms-film negatives at a scale of 1:12,000 and linen tracings at a scale of 1:6,000. The latter were tracings on Imperial Linen taken directly from the manuscripts. However, since the maps were compiled in three minute sheets and the limits of the linen tracings were based on the Georgia State Grid, it was necessary to trace parts of as many as four manuscripts to complete one linen.

The preparation of the final three minute sheets involved a considerably different process. The manuscripts were first copied photographically at a reduced scale on a stable film. Metal mounted boards - simply good drawing paper mounted onto sheets of aluminum - were sensitized and blue line prints made from the negatives mentioned above. This procedure was followed to maintain maximum accuracy. Final drafting was then done in black ink on these "Blue Line Boards". All drafting was done in accordance with Army Map Service Specifications which requires strict adherence to line weights for all detail. Upon completion of the drafting a clear sheet of vinyl base or other stable material was overlayed on the boards and the outline of all vegetation was drawn thereon. These wooded areas were then painted in with opaque and subsequently combined with final map. The next step was to add to the boards the names of towns, streams and other features; contour and grid values; highway numbers, proper title, etc. This information had been previously assembled and printed on a wax backed material which was then "stuck-up" in proper positions.

The map was then given its final edit. If found satisfactory, it was again copied photographically to a scale of 1:12,000 on a stable film and the woods overlay was copied also to the same scale. These two negatives were used to prepare the final film composite from which were made reproductions of the maps on paper. The finished maps were bound in volumes for ready use.

In addition to obtaining the 6 inch mapping photography previously mentioned, the area was also photographed with a Park Precision Camera containing a 12 inch lens. The fact that the longer focal length lens contains little parallax, makes it more desirable in obtaining photography to be used in construction of mosaics. The first step in preparing the mosaic was the construction of grids on sheets of Masonite. Control points were then chosen and transferred from the map sheets to the Masonite boards. These were identifiable points such as road intersections, culvert crossings, driveways, etc. They were first used to

compute ratio factors for making photographs to proper scale. After the ratio prints were made they were pasted to the masonite boards, extreme care being taken that the chosen points on the pictures matched the same points when placed on the boards. After all photos were laid on the boards, place names and other information were added. The boards were then copied at a scale of 1:12,000. It was required to show certain contours on the mosaics also. These contours were traced from the map sheets and also copied. Photographic prints were then made by double printing the mosaic negatives and the contour negatives.

The methods and procedures as outlined are more or less standard with private companies and with various Federal Government Agencies engaged in the preparation of contour maps and mosaics.

A conservative estimate as to comparison in time and costs between the methods used and those that would have been employed in usual field methods in mapping this area is that the latter would have been double that of the former.

Any project of this size presents various problems, many of them peculiar to the particular project but none too serious if the work has been carefully planned. Each phase of the work is dependent upon the accuracy with which the previous operation has been performed. Poor photography may result in the necessity for additional control and an increased number of models. Errors in control may cause the loss of many man hours on the plotting instruments. Inaccuracies and carelessness in plotting are reflected in the speed with which the Draftsmen can complete their part of the work.

It can be said that much energy has been expended over the past 10 years toward getting results in a hurry. Map makers and users throughout the world have turned to photogrammetry to help meet the demands for accurate maps that are needed "Right Now."

PROCEEDINGS-SEPARATES

The technical papers published in the past twelve months are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

VOLUME 79 (1953)

MARCH: 176(SA), 177(EM), 178(HY), 179(EM), 180(HY), D-123(HY), D-126(ST), D-128(ST).

APRIL: 181(WW), 182(ST), 184(HY), 185(EM), 186(HY), 187(ST), 188(HY), D-135(HY), D-136(ST).

MAY: 189(HY), 190(HY), 191(CP) & (AT), 192(SM), 193(HY), D-129(PO), D-138(CP), D-145(ST).

JUNE: 194(CP) & (AT), 195(SM), 196(CP) & (AT), 197(HY), 198(ST), 199(EM), D-134(HY), D-141(HY).

JULY: [a] 200(SM)[b], 201(ST)[b], 202(EM)[b], 203(SM)[b], 204(AT)[b], 205(EM)[b], 206(ST)[b], 207(SA)[b], 208(SA)[b], 209(ST)[b], 210(SU)[b], 211(EM)[b], 212(SU)[b], 213(IR)[b], 214(HW)[b], 215(SM)[b], 216(ST)[b], 217(ST)[b], 218(ST)[b], 219(ST)[b], 220(SM)[b], 221(HW)[b], 222(SM)[b], 223(EM)[b], 224(EM)[b], 225(EM)[b], 226(CO)[b], 227(SM)[b], 228(SM)[b], 229(IR)[b].

AUGUST: 230(HY), 231(SA), 232(SA), 233(AT), 234(HW), 235(HW), 237(AT), 238(WW), 239(SA), 240(IR), 241(AT), 242(IR), 243(ST), 244(ST), 245(ST), 246(ST), 247(SA), 248(SA), 249(ST), 250(EM)[c], 251(ST), 252(SA), 253(AT), 254(HY), 255(AT), 256(ST), 257(SA), 258(EM), 259(WW).

SEPTEMBER: 260(AT), 261(EM), 262(SM), 263(ST), 264(WW), 265(ST), 266(ST), 267(SA), 268(CO), 269(CO), 270(CO), 271(SU), 272(SA), 273(PO), 274(HY), 275(WW), 276(HW), 277(SU), 278(SU), 279(SA), 280(IR), 281(EM), 282(SU), 283(SA), 284(SU), 285(CP), 286(EM), 287(EM), 288(SA), 289(CO).

OCTOBER: [d] 290(all Divs), 291(ST)[c], 292(EM)[c], 293(ST)[c], 294(PO)[c], 295(HY)[c], 296(EM)[c], 297(HY)[c], 298(ST)[c], 299(EM)[c], 300(EM)[c], 301(SA)[c], 302(SA)[c], 303(SA)[c], 304(CO)[c], 305(SU)[c], 306(ST)[c], 307(SA)[c], 308(PO)[c], 309(SA)[c], 310(SA)[c], 311(SM)[c], 312(SA)[c], 313(ST)[c], 314(SA)[c], 315(SM)[c], 316(AT), 317(AT), 318(WW), 319(IR), 320(HW).

NOVEMBER: 321(ST), 322(ST), 323(SM), 324(SM), 325(SM), 326(SM), 327(SM), 328(SM), 329(HW), 330(EM)[c], 331(EM)[c], 332(EM)[c], 333(EM)[e], 334(EM), 335(SA), 336(SA), 337(SA), 338(SA), 339(SA), 340(SA), 341(SA), 342(CO), 343(ST), 344(ST), 345(ST), 346(IR), 347(IR), 348(CO), 349(SM), 350(HW), 351(HW), 352(SA), 353(SU), 354(HY), 355(PO), 356(CO), 357(HW), 358(HY).

DECEMBER: 359(AT), 360(SM), 361(HY), 362(HY), 363(SM), 364(HY), 365(HY), 366(HY), 367(SU)[e], 368(WW)[e], 369(IR), 370(AT)[e], 371(SM)[e], 372(CO)[e], 373(ST)[e], 374(EM)[e], 375(EM), 376(EM), 377(SA)[e], 378(PO)[e].

VOLUME 80 (1954)

JANUARY: 379(SM)[e], 380(HY), 381(HY), 382(HY), 383(HY), 384(HY)[e], 385(SM), 386(SM), 387(EM), 388(SA), 389(SU)[e], 390(HY), 391(IR)[e], 392(SA), 393(SU), 394(AT), 395(SA)[e], 396(EM)[e], 397(ST)[e].

FEBRUARY: 398(IR)[f], 399(SA)[f], 400(CO)[f], 401(SM)[f], 402(AT)[f], 403(AT)[f], 404(IR)[f], 405(PO)[f], 406(AT)[f], 407(SU)[f], 408(SU)[f], 409(WW)[f], 410(AT)[f], 411(SA)[f], 412(PO)[f], 413(HY)[f].

MARCH: 414(WW)[f], 415(SU)[f], 416(SM)[f], 417(SM)[f], 418(AT)[f], 419(SA)[f], 420(SA)[f], 421(AT)[f], 422(SA)[f], 423(CP)[f], 424(AT)[f], 425(SM)[f], 426(IR)[f], 427(WW)[f].

a. Beginning with "Proceedings-Separate No. 200," published in July, 1953, the papers were printed by the photo-offset method.
b. Presented at the Miami Beach (Fla.) Convention of the Society in June, 1953.
c. Presented at the New York (N.Y.) Convention of the Society in October, 1953.
d. Beginning with "Proceedings-Separate No. 290," published in October, 1953, an automatic distribution of papers was inaugurated, as outlined in "Civil Engineering," June, 1953, page 66.
e. Discussion of several papers, grouped by divisions.
f. Presented at the Atlanta (Ga.) Convention of the Society in February, 1954.

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